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ABSTRACT

In recent years, the relationship between moods and thoughts has been the focus of much theorizing and some empirical work. A study was undertaken to examine the intraindividual relationship between negative affect and negative thoughts using a Box-Jenkins time series analysis. College students (N=33) completed a measure of negative mood and thoughts twice daily for 61 consecutive days. A negative thought scale derived from the Automatic Thoughts Questionnaire and a measure of the broad dimension of negative affect were scored. Autoregressive, integrated, moving-average (ARIMA) modeling for each individual's negative affect and thought series indicated considerable day-to-day dependency. Cross-correlations of the prewhitened series indicated that 21 subjects (64%) showed a relationship between mood and thought at the same time point, and 9 subjects (27%) showed a causal relationship between morning mood and evening thought, or vice versa. Overall, the findings suggest that the temporal-causal order of these relationships appears more complex than existing theories would predict. A number of reasons are possible for the lack of clear association between causal orders. (Author/NB)

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The Relationship of Negative Affect and Thought:

Time Series Analyses

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Abstract

This study examined the intraindividual relationship between negative affect and negative thoughts using a Box-Jenkins time series analysis. Thirty-three subjects completed a measure of negative mood and thoughts twice daily for sixty-one consecutive days. A negative thought scale derived from the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980) and a measure of the broad dimension of negative affect were scored. ARIMA modeling for each individual's negative affect and thought series indicated considerable day-to-day dependency. Cross-correlations of the prewhitened series indicated twenty-one subjects (64%) showed a relationship beween mood and thought at the same time point, and nine (27%) subjects showed a causal relationship between morning mood and evening thought, or vice versa. Overall, the findings indicate that the temporal-causal order of these relationships appears more complex than existing theories would predict. A number of reasons for the lack of clear association between causal orders were discussed.

The Relationship of Negative Affect and Thought: Time Series Analyses

In recent years, the relationship between moods and thoughts, particularly in cases of depression, has been the focus of much theorizing and some empirical work in the clinical literature (Beck, Rush, Shaw, & Emery, 1979; Lewinsohn, Steinmetz, Larson, & Franklin, 1981). In particular, cognitively-oriented theorists argue that cognitions precede and are causally related to affect (Lazarus, 1984, 1982), while others just as vehemently defend the position that cognition and affect occur independently of each other, or that affect often precedes thoughts (Zajonc, 1984, 1980). Lewinsohn, et al. (1981) tested these hypotheses by measuring depressed and non-depressed subjects' attributions, expectancies, irrational beliefs, and perceived control at two time points. They found support for the hypothesis that depressive symptoms and negative cognitions covary, but did not find any evidence to support the belief that negative thoughts precede a depressive episode. Teasdale (1983) summarized a series of studies in which inducing a depressed mood seemed to increase the accessibility of negative cognitions relative to positive ones, and only one instance in which inducing change in negative thoughts also induced a positive change in mood.

In view of the fact that so much attention has been focused on these issues, it is surprising that there have been so few investigations which examine the relationship of negative moods and thoughts from a longitudinal, intraindividual perspective grounded in the individual's natural environment. The purpose of the present study is to investigate the relationship between negative mood and thoughts using a set of observations made of individuals over a period of two months. The Box and Jenkins (1970)

autoregressive, integrated, moving-average (ARIMA) procedure was used with a cross-correlation analysis to map the relationship between negative moods and thoughts on the same day. The ARIMA stochastic process models were selected because of their demonstrated usefulness in a number of areas of inquiry (Gottman & Glass, 1978).

Prior investigations of the relationship between mood and thought have assessed mood in terms of a large number of distinct emotional factors. The present study looks at this relationship by conceptualizing mood as consisting of two broad dimensions; positive and negative affect (Watson, Clark & Tellegen, 1984; Watson & Tellegen, 1985; Zevon & Tellegen, 1982). The dimensions of positive and negative affect have been shown to be related to a number of important psychological processes such as well-being (Bradburn & Caplovitz, 1965; Diener & Larsen, 1984a) and dimensions of personality (Costa & McCrae, 1980; Rounds, Zevon & Stoops, 1984).

Although the dimensions of negative and positive thoughts are central to current thinking in cognitive theories of emotion, their existence as two separate and independent factors has not been discussed or tested. The presence of positive thoughts as a component of subjective well-being has been well-documented (Diener & Larsen, 1984a; 1984b). The presence of negative thoughts, at least as they relate to depression, have also been researched (Beck et al., 1979). In this study, the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980) was used as a measure of negative cognitions. This measure was developed and normed on college students, and is meant to reflect thoughts that are expected to fluctuate with depressive symptoms, therefore it seemed ideally suited to the purpose of this investigation.

Method

Subjects

The participants in this study were 42 students from a large university in upstate New York. Two students dropped out during the data collection phase. The data collected from seven other students was excluded from this analysis due to concerns about the accuracy of the subjects' self-reports. Of the 33 subjects remaining, 25 were first year graduate students, and 8 were undergraduates. The participants ranged in age from 19 to 45 years; 26 were female and 7 were male.

Measures

The checklist used in the present investigation consisted of 25 mood adjectives and 12 thought items. The mood items were selected to ensure broad coverage of the domain of negative affect. The items were selected from a 60-item checklist used in a number of prior investigations (Watson & Tellegen, 1985; Zevon & Tellegen,1982) to assess the two orthogonal mood dimensions of positive and negative affect. Participants recorded how they felt at the time they completed the checklist by endorsing the adjectives on a five-point scale labeled "very slightly or not at all", "a little", "moderately", "quite a bit", and "very much". The 12 thought items were statements from the first two factors, Personal Maladjustment (5 items) and Negative Self-Concept (7 items), of the Automatic Thoughts Questionnaire (ATQ; Hollon & Kendall, 1980). The ATQ was devised to measure the frequency of occurrence of negative self-statements associated with depression. Participants recorded the frequency with which they experienced these thoughts by endorsing a five-point scale labeled "not at all", "sometimes", "moderately often", "often", and "all the time".

Participants completed the checklist twice daily. To minimize position effects, two forms of the mood adjectives and two forms of the thought statements were constructed by randomizing the sequence of item presentation. The order of presentation of moods and thoughts were then counterbalanced, resulting in four versions of the checklist.

Procedures

Participants completed the mood and thought questionnaire twice daily, within two hours after rising and within two hours of retiring. The data collection lasted for 61 consecutive days (120 data points), starting in the evening of the first day and ending on the morning of the sixty-first day. Completed forms were collected twice weekly.

Analysis

Scale scores for negative mood were constructed by summing the endorsed values for the adjectives that load on the negative affect dimension identified by Zevon and Tellegen (1982). Scale scores for the negative thought factor were similarly derived. The two scores for each subject for each time point were then converted to z-scores. These scores were then used in a time series analysis.

Three judges (the authors) independently identified ARIMA models as described by Box and Jenkins (1970) for each subject's mood and thought series based on the autocorrelation functions (ACFs) and partial autocorrelation functions (PACFs). The ACFs and PACFs for the residuals of these models were then examined for independence at the first and second lags to determine whether they were distributed as white noise (McCleary & Hay, 1980). The Ljung-Box Q statistic (Ljung & Box, 1978) was used to determine whether the residual ACFs were different from what would be expected of a white noise process. These procedures were similar to

McCleary and Hay's identification, estimation, and diagnosis strategy.

For each subject, the negative mood and negative thought scores were prewhitened through their respective ARIMA models (Cook & Campbell, 1979). The residuals were then sorted into separate morning and evening time series, resulting in four series for each subject (morning mood, morning thoughts, evening mood, evening thoughts). These reordered series each had 59 time points, since there were 59 full days in which data were collected. The zero lag cross-correlations were calculated by correlating the morning mood series with the morning thoughts series and the evening mood series with the evening thoughts series. The zero lag cross-correlations from the original series were also calculated for comparison with the reordered series.

In order to study the effects of mood in the morning on thoughts in the evening and the effects of thoughts in the morning on mood in the evening, cross-correlations of the appropriate series were computed. The negative affect series in the morning was cross-correlated with the evening thought series for each subject. Likewise, the morning thought series was cross-correlated with the evening affect series for each subject A cross-correlation function (CCF) coefficient greater than two standard errors was considered to be statistically different than zero. Calculated in this manner, the cross-correlation between two time series can provide information not only about the strength of a relationship between two variables, but also about direction (Cook & Campbell, 1979; McCleary & Hay, 1980).

Results

ACFs and PACFs

Examination of significant (greater than two standard errors) first and second lag ACFs and PACFs revealed that all but 3 negative affect and 3 negative thought series showed significant first or second lags. Thus, there appears to be considerable morning to evening or day to day dependency within these series.

ARIMA MODELS

The negative affect series included 17 first order autoregressive models, 5 first-order moving-average models, 4 regularly differenced moving-average models, and 1 regularly differenced autoregressive model. There was also 1 series with both first and second order autoregressive parameters, 1 with first and third order autoregressive parameters, and 1 with a fourth-order autoregressive parameter. The remaining 3 negative affect series were identified as white noise.

The negative thought series included 15 first-order autoregressive series, 1 regularly differenced autoregressive series, and 10 regularly differenced moving-average series. There were also 4 second-order autoregressive series, 1 series with both first and second order autoregressive parameters, and 1 series with a fourth order autoregressive parameter. The remaining 2 negative thought series were identified as white noise.

CCFs

Once the models for each series were identified and the appropriate time series prewhitened, cross-correlations were computed as described above. In Table 1 the cross-correlations for negative mood and thought series at the zero lag are presented. About half (48%) of the cross-

correlations between the original series were significant. The usefulness of segregating out morning and evening series from each other is evident in the next two columns of the table. Inspection of the separate morning and evening series coefficients in Table 1 shows that the correlation coefficient of the original series appears to be a weighted average of the other two. This resulted in obscuring significant relationships in 6 of the original series (e.g., subjects 12, 27). A little over one-third (39%) of the cross-correlations of morning moods with thoughts were significant; about one-half (52%) of the cross-correlations of evening moods with thoughts were significant. Overall, 64% of the subjects showed significant cross-correlations between either the morning series alone, the evening series alone, or at both times of the day.

Insert Table 1 about here

Table 2 contains the cross-correlations between morning and evening series within days. Eighteen percent of the cross-correlations between morning moods and evening thoughts were significant; Nine percent of the cross-correlations between morning thoughts and evening moods were significant.

Insert Table 2 about here

Discussion

This study set out to describe mood and thought processes from a longitudinal perspective, with a primary interest in developing a model

describing the causal relationships between negative thoughts and negative affect. Rather than finding the easily interpretable and unambiguous results which many current cognitive theories would predict, the analysis strongly suggests complexity both within and between individuals. These results are consistent with previous research (Lewinsohn, et al., 1981; Rounds, Zevon, & Donnelly, 1985), which found significant concomitant relationships between affect and cognition but found no support for the role of cognition as an antecedent or as a consequence of affect. Similarly, Diener and Larsen (1984) recently concluded that cross-situational consistency of affective, behavioral, and cognitive responses differs depending on the individuals, situations, and responses examined. In the present investigation, negative mood and thoughts at the same time point covaried in well over half the participants, but the strength, direction, and pattern of this relationship was unique to each individual. In half the cases, mood and thoughts were significantly related in the evening; in other cases, the relationship occurred only in the morning. Only 9 participants showed evidence of a significant relationship at both times of the day. These results are consistent with the findings of Christie and Venables (1973), who found a significant time of day effect on most mood dimensions.

In examining the evidence for mood driving thought or thought driving mood, less than 27% of the subjects showed a significant relationship between affect and cognition in either direction within the same day. Interestingly, 2 of the 3 significant correlations between thought in the morning and mood in the evening were negative. This may indicate that for these individuals, the more negative their thoughts are in the morning, the the less negative their feelings are in the evening. Perhaps for these

people the experiences of the day disconfirm their negative thoughts about themselves; it would be interesting to speculate on their vulnerability to depression based on life events. Apparently, the role of individual differences in the relationship between mood and thoughts is more salient than previous empirical and theoretical work has indicated.

One of the difficulties experienced in interpreting the results of this study is that currently there is no adequate taxonomy of positive and negative thoughts. Undoubtedly, the domain of negative thoughts was not exhaustively covered by the twelve items used in this study. An example of such an omission might be thoughts reflecting more anxious rather than just depressed states. Another possible shortcoming of this study is that the cognitions used here may be more stable over time than moods, making it difficult to demonstrate a clear relationship between the two on a daily basis. A strong case has been made for just such a conclusion in the area of subjective well-being. Andrews and Withey (1976), among others, provide evidence that subjective well-being is a construct with three dimensions; positive affect, negative affect, and a cognitive evaluation component. The cognitive component is quite stable over time, whereas the affective components show more variability. The apparent lack of relationship between the cognitive and affective components in some individuals may be due to a lack of variability of cognitions over time. Future investigations that attempt to deal with these shortcomings might show stronger evidence of a causal relationship between negative affect and thought.

The data presented here suggest that complete specification of the causal forces within and between moods and thoughts will require a great deal more work on both theoretical and empirical levels. Future research

will benefit from a perspective incorporating careful attention to reliable measurement of all relevant variables, consideration of temporal parameters and individual differences, and strong data analytic techniques permitting examination of specific hypotheses.

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Table 1

Cross-Correlations of Moods and Thoughts at the Same Time Point (Zero Lag)

Subject	Original Series (120 time points)	Reordered Series (59 time points)	
		Morning	Evening
1	.06	-.15	.12
2	.36*	.39*	.31*
3	.03	.15	-.10
4	-.39*	-.42*	-.38*
5	-.28*	-.10	-.48*
6	.27*	.20	.43*
7	.75*	.79*	.71*
8	-.07	-.28*	.01
10	.39*	.24	.46*
11	.37*	.31*	.41*
12	.13	.00	.27*
13	.24*	-.13	.43*
14	.08	.01	.11
17	-.36*	-.49*	-.30*
18	-.08	-.20	-.12
19	-.01	-.10	.07
20	.75*	.80*	.71*
21	.18	.31*	.08
22	.35*	.30*	.42*
24	-.17	-.17	-.18

Continue Table 1

Subject	Original Series	Reordered Series	
		Morning	Evening
26	-.15	.04	-.32*
27	.09	-.13	.25*
28	.47*	.31*	.58*
29	-.15	-.29*	-.05
31	.40*	.53*	.29*
33	-.02	.25	-.25
34	.21*	.25	.21
36	.02	-.11	.14
37	.17	.26	.11
39	.07	-.01	.14
40	-.24*	-.18	-.27*
42	.30*	.40*	.17
43	.02	.07	.06

Note: Correlations greater than two standard errors are considered statistically significant, and are starred.

Table 2

Cross-Correlations of Moods and Thoughts from Morning to Evening

Subject	Morning Moods with Evening Thoughts	Morning Thoughts with Evening Moods
1	.24*	-.19
2	-.12	.13
3	.25*	-.08
4	-.27*	-.03
5	-.13	-.17
6	.32*	.07
7	-.10	-.04
8	-.12	-.14
10	.04	.11
11	.18	-.22*
12	.10	.21
13	.03	-.05
14	-.02	-.09
17	.13	.27*
18	-.12	-.06
19	-.17	-.23
20	-.10	-.04
21	.11	.02
22	.22	-.17
24	-.22	-.06

Continue Table 2

Subject	Morning Moods with Evening Thoughts	Morning Thoughts with Evening Moods
26	-.09	-.25
27	.28*	.10
28	.06	-.09
29	-.18	.20
31	-.09	-.44*
33	.08	-.01
34	.17	-.12
36	-.15	.04
37	.04	-.19
39	.33*	.23
40	.05	.18
42	.05	.18
43	.08	-.07

Note: Correlations greater than two standard errors are considered statistically significant, and are starred.